

P2002J114

ART 34 AMDT

EPO - DG 1

03. 02. 2005

(75)

CLAIMS

1. A process for the manufacture of a catalyst comprising a catalytically active metal dispersed on a support, which process comprises:
  - 5 a) preparing a support having an organic complex of the catalytically active metal deposited thereon by treating a porous support with a compound or salt of the metal and a nitrogen-containing organic compound selected from (i) amino acids and (ii) compounds containing both an amino group and an alcohol group, to form the organic metal  
10 complex on the support;
  - b) partially decomposing the organic metal complex on the support to the extent that the partially decomposed product (I) retains between 10 and 95% by weight of the dry weight attributed to the organic complex prior to partial decomposition, and (II) exhibits one or more infra-red  
15 absorption bands between 2100-2200  $\text{cm}^{-1}$  that are not present in the organic complex before partial decomposition; and
  - c) converting the partially decomposed organic metal complex into catalytically active metal.
- 20 2. The process as claimed in claim 1 wherein the conversion to catalytically active metal is achieved by treatment of the support comprising the partially decomposed organic metal complex with a reductant.
3. The process as claimed in claim 2 wherein the reductant is a source of  
25 hydrogen and/or CO.
4. The process as claimed in claim 2 or 3 wherein the source of reductant is provided in-situ in a catalysed process.

P2002J114

ART 34 AMDT

5. The process as claimed in any one of claims 2 to 4 wherein the source of reductant is provided in a catalyst regeneration process.
- 5 6. The process as claimed in any one of claims 2 to 5 wherein the source of reductant is provided in a catalyst regeneration process or catalyst recycle process associated with a catalysed process.
- 10 7. The process as claimed in any one of the preceding claims wherein the nitrogen-containing organic compound has been incorporated into or within the support during its manufacture or synthesis.
- 15 8. The process as claimed in any preceding claim wherein the nitrogen-containing organic compound is an aliphatic amine containing one or more hydroxyl groups.
9. The process as claimed in claim 8 wherein the amine comprises an hydroxyalkyl group.
- 20 10. The process as claimed in claim 9 wherein the hydroxyalkyl group is C<sub>1</sub> - C<sub>50</sub> - hydroxyalkyl.
11. The process as claimed in claim 10 wherein the hydroxyalkyl group is C<sub>1</sub> - C<sub>8</sub> - hydroxyalkyl.
- 25 12. The process as claimed in claim 11 wherein the hydroxyalkyl group is C<sub>1</sub> - C<sub>4</sub> - hydroxyalkyl.
13. The process as claimed in claim 12 wherein the hydroxyalkyl group is selected from: hydroxymethyl, 1-hydroxyethyl, 2-hydroxyethyl, 1-

P2002J114

ART 34 AMDT

hydroxy-n-propyl, 2-hydroxy-n-propyl, 3-hydroxy-n-propyl and 1-hydroxy-methyl-ethyl.

- 5 14. The process as claimed in claim 13 wherein the nitrogen-containing organic compound comprises a mono-, di-, or tri-, substituted aliphatic hydroxyalkylamine.
- 10 15. The process as claimed in claim 14 wherein the hydroxyalkylamine comprises one or more of: methanolamine, di-methanolamine, tri-methanolamine, ethanolamine, di-ethanolamine, tri-ethanolamine, butanolamine, di-butanolamine, tri-butanolamine, propanolamine, di-propanolamine, dimethylethanolamine, di-isopropylethanolamine, methyldiethanolamine, dimethylamino-2-propanol and tri-propanolamine.
- 15 16. The process according any one of claims 1 to 7 wherein the amino acid is L-arginine.
- 20 17. The process as claimed in any one of claims 1 to 7 wherein the amino acid is selected from all isomers of the following: alanine, arginine, asparagines, aspartic acid, cysteine, cystine, 3, 5-dibromotyrosine, 3,5-diiodotyrosine, glutamic acid, glutamine, glycine, histidine, hydroxylysine, hydroxyproline, isoleucine, leucine, lysine, methionine, phenylalanine, proline, serine, threonine, thyroxine, tryptophane, tyrosine and valine.
- 25 18. The process according to any one or the preceding claims wherein the organic metal complex is partially decomposed by calcination or pyrolysis.

P2002J114

ART 34 AWDI

- 5 19. The process as claimed in claim 18 wherein the calcination temperature is less than the temperature, as determined by TGA in air, at which total weight loss of the organic complex occurs or the pyrolysis temperature is less than the temperature, as determined by TGA in an inert atmosphere of hydrogen, at which total weight loss of the organic complex occurs.
- 10 20. The process as claimed in claim 19 wherein the calcination or pyrolysis temperature is between 200 °C and the temperature at which total weight loss of the organic complex occurs.
- 15 21. The process as claimed in any one of claims 18 to 20 wherein the partial decomposition is performed by introduction of the support comprising the organic metal complex into a catalysed process, a catalyst regeneration process or a catalyst recycle process.
- 20 22. The process as claimed in any preceding claim wherein, in the catalyst formed by the process, the total metal dispersion is 45% or more and the metal dispersion relating to a strongly chemisorbed component of the total metal dispersion is 20% or greater.
- 25 23. The process as claimed in any preceding claim wherein the product of step (b) exhibits dispersion values relating to the strong dispersion component of less than 1%.
24. The process as claimed in claim 23 wherein the dispersion is less than 0.5%.
25. The process as claimed in any preceding claim wherein step (b) is performed to the extent that the partially decomposed product retains

P2002J114

ART 34 ANDT

between 20 and 75 % by weight of the dry weight attributed to the organic complex prior to partial decomposition.

5 26. The process as claimed in any one of the preceding claims wherein the catalyst support comprises silica.

27. The process as claimed in claim 26 wherein the silica is amorphous.

10 28. The process as claimed in any one of the preceding claims wherein the support comprises an ordered mesoporous material and/or a macroporous material.

15 29. The process as claimed in any one of the preceding claims wherein the support comprises a material designated as M41S.

30. The process as claimed in claim 29 wherein the support material is MCM-41.

20 31. The process as claimed in any one of the preceding claims wherein the support comprises alumina.

25 32. The process as claimed in any one of the preceding claims wherein the support comprises rutile titanium dioxide, anatase titanium dioxide or mixtures thereof.

33. The process as claimed in claim 32 wherein the support further comprises zirconium dioxide.

P2002J114

ART 34 Amend

34. The process as claimed in any one of the preceding claims wherein the salt or compound of one or more catalytically active metals is a salt or compound of one or more metals selected from the following groups:  
Group 1 (Group IA) such as Li, Na or K; Group 2 (Group IIA) such as Mg, Ca and Sr; Group 3 (Group IIIA, IIIB) such as Sc, Y and La; Group 4 (Group IVA, IVB) such as Ti, Zr and Hf; Group 5 (Group VA, VB) such as V, Nb and Ta; Group 6 (Group VIA, VIB) such as Cr, Mo and W; Group 7 (Group VIIA, VIIB) such as Mn, Tc, and Re; Groups 8, 9 and 10 (Group VIII, VIIIA) such as Fe, Ru, Os, Co, Rh, Ir, Ni, Pd, and Pt; Group 11 (Group IB) such as Cu, Ag, and Au; Group 12 (Group IIB) such as Zn; Group 13 (Group IIIA, IIIB) such as Ga and In; and Group 14 (Group IVA, IVB) such as Ge and Sn.
35. The process as claimed in claim 34 wherein the salt or compound of one or more catalytically active metals is a salt or compound of one or more of the following metals; copper, platinum, rhodium, palladium, cobalt, iron, nickel, rhenium, ruthenium or a mixture of two or more thereof as active metal.
36. The process according to any preceding claim wherein the compound or salt of the catalytically active metal is a nitrate or nitrosyl nitrate.
37. A process for the production of  $C_5+$  liquid hydrocarbons from a hydrogen and carbon monoxide synthesis gas by contact of the said gas at reaction conditions with a catalyst as manufactured by the process as claimed in any one of the preceding claims.
38. A method for the removal of sulfur from a mixture comprising one or more organic compounds and one or more sulfur containing compounds,

P2002J114

ART 34 AMDI

5

in which method the mixture is contacted with one or more materials comprising active metal dispersed on an inorganic support under such conditions that sulfur is adsorbed onto the material comprising active metal dispersed on an inorganic support and wherein the material comprising active metal deposited on a support is a catalyst as manufactured by the process as claimed in any one of claims 1 to 36.